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For:

## A Filter System With Reduced Switch Thermal Noise and a $\Sigma\Delta$ Modulator Using Such a Filter

1. A filter system with reduced switch thermal noise comprising:

- an input circuit for receiving an input signal and a feedback signal and providing a signal representative of the difference;
- a filter circuit including at least an input sampling capacitor and switch which introduces thermal noise error;
- a feedback circuit, responsive to said filter circuit, for delivering to said input circuit said feedback signal; and
- said input circuit including means for amplifying said difference signal, before it is submitted to said filter circuit to reduce the input-referred thermal noise by a factor of approximately the gain of the amplification.

2. The filter system with reduced switch thermal noise of claim 1 in which said gain is greater than one.

3. The filter system with reduced switch thermal noise of claim 1 in which said input circuit includes a summing circuit for receiving an input signal and a feedback signal and providing a signal representative of the difference and an amplifier circuit for amplifying said difference signal, before it is submitted to said filter circuit to reduce the input-referred thermal noise by a factor of approximately the gain.

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noise comprising:

4. A  $\Sigma\Delta$  modulator with a filter system having reduced switch thermal noise comprising:
- an input circuit for receiving an input signal and a quantized feedback signal and providing a signal representative of the difference;
  - a filter circuit including at least an input sampling capacitor and switch which introduces thermal noise error;
  - a quantizer circuit for quantizing the output of said filter circuit;
  - a feedback circuit, responsive to said quantizer circuit, for delivering to said input circuit said quantized feedback signal; and
  - said input circuit including means for amplifying said difference signal, before it is submitted to said filter circuit to reduce the input-referred thermal noise by a factor of approximately the gain of the amplification.

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5. The  $\Sigma\Delta$  modulator with a filter system having reduced switch thermal noise of claim 4 in which said gain is greater than one.

6. The  $\Sigma\Delta$  modulator with a filter system having reduced switch thermal noise of claim 4 in which said input circuit includes a summing circuit for receiving an input signal and a feedback signal and providing a signal representative of the difference and an amplifier circuit for amplifying said difference signal, before it is submitted to said filter circuit to reduce the input-referred thermal noise by a factor of approximately the gain.

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A  $\Sigma\Delta$  modulator with a filter system having reduced switch thermal noise comprising:

a summing circuit for receiving an input signal and a quantized feedback signal and providing a signal representative of the difference;

a filter circuit including at least an input sampling capacitor and switch which introduces thermal noise error;

a quantizer circuit for quantizing the output of said filter circuit;

a feedback circuit, responsive to said quantizer circuit, for delivering to said summing circuit said quantized feedback signal; and

an amplifier circuit for amplifying said difference signal, before it is submitted to said filter circuit to reduce the input-referred thermal noise by a factor of approximately the gain of said amplifier circuit..

10. A  $\Sigma\Delta$  modulator with a filter system having reduced switch thermal

noise of claim 9 in which said amplifier circuit has a gain greater than one.

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